

Abstract No.: Ding0493

Searching a broken time-reversal symmetry in high temperature superconductors

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Beamline(s): U5UA

Introduction: There is a phenomenon of so-called pseudogap in the underdoped HTSC. This pseudogap is closely related to both the Mott insulating gap and the superconducting gap. Whether or not a symmetry is broken in this pseudogap state is crucial in determining the nature of this state. In addition, it may hold a key to understand the mechanism of high- T_c superconductivity. The photoemission dichroism experiment by using the circularly polarized light is believed to be the only probe to search some type of hidden symmetry breaking [1]. A recent photoemission study has provided some evidence of the existence of such broken symmetry [2], although the dichroism signals are compatible to error bars. Therefore it is very important to further refine the measurement. The U5UA beamline of NSLS with a quadrupole reflector circular polarizer is a good place to perform this experiment due to its stability of beam. We are currently collaborating with Elio Vescovo of NSLS and Peter D. Johnson of Physics Department at BNL to search the broken time-reversal symmetry in the high temperature superconductors.

Methods and Materials: ARPES dichroism on single crystals $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$

References:

[1] C.M. Varma, "Proposal for an experiment to test a theory of high-temperature superconductors", Phys. Rev. B **61**, R3804-R3807 (2000).

[2] A. Kaminski, S. Rosenkrantz, H.M. Fretwell, J.C. Campuzano, Z. Li, H. Raffy, W.G. Cullen, H. You, C.G. Olson, C.M. Varma, and H. Hochst, "Spontaneous breaking of time-reversal symmetry in the pseudogap state of a high- T_c superconductor", Nature **416**, 610-613 (2002).